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## At the Back of the Pantry Door

In the train we listened with interest to some instructions being given to a young housewife on domestic cleaning. Each morning it seems it is necessary to run over all carpets with the Ewbank, Bissell, or some such sweeper, to dust everything within reach, change the water in the flower vases, and do sundry other jobs, which we fail to remember. Then the next phase was that each week it is necessary to go over the carpets with a vacuum, polish the furniture, and clean the windows. Finally, twice a year one has to take down the heavy curtains and send them to the cleaners; one has to move all heavy furniture, and there was something extra to be done to the furniture, using vinegar. To cap all, a rota of duties was to be pinned up at the back of the pantry door.

As we listened to all this—no less intently than the newly wed—we wondered whether such a logical programme was invariably instituted and whether one type of management could be honestly labelled "sluttish." On arrival at our destination, the post brought us our copy of the Transactions of the American Foundrymen's Association, and our attention was at once arrested by a Paper on this subject written by Mr. Frank J. Dost, of the Sterling Foundry Company. His thesis was exactly on the same lines as the unknown lady in the train, but in reverse. He started off with the note on the back of the pantry door, and then detailed annual, weekly, and daily duties. Primarily, he schedules maintenance as being taken care of by three separate departments, which co-ordinate their activities—electrical, buildings and mechanical maintenance. The motto he gives for this work is the homely one of "a stitch in time saves nine."

The system he enumerates is to inspect the following every six months:—Outdoor sub-station, pole lines, power lines, buildings, fences, bridges, roads, slacks, manholes, and safety belts. For quarterly inspection, he includes sewers, petrol tanks, floor loading, and the sprinkler systems. Monthly duties cover jibs, elevators, conveyors, lifting devices, chain blocks, hoists, runways, trolley wire, all types of slings, crane cables, chains, switchboards, furnaces, power cables, transformers, core ovens and scales—the last and penultimate items to receive special care. Weekly inspections are undertaken to include pressure tanks, ventilation, exhausters, blowers, travelling cranes, shot blast, electrical devices, chipping hammers, portable grinders, and pneumatic rammers. Finally there is to be a continuous inspection of Sandslingers, sand mixers, sand cutters, knock-out machines, air compressors, Hydro-Blast, piping of all kinds, electric wiring, ladders, grinding wheels, yards, drinking fountains, toilets, fire protection, and also listed for special supervision are moulding machines, cupola blowers, and belt conveyors.

Pondering over this somewhat formidable list, we were reminded of a simple money-saving system we put into force during the last war when our job was to instal and put into commission British electric furnaces mainly on the Continent. Our method was to scrounge an office and list every job to be done for the complete erection in the first column. Then, in co-operation with the works engineer, the name of the official responsible for each job was added, and beside it the date when his department would start and finish. Our bottle-neck in those days—and probably to-day also—was pipe fitting. After being held up for days on the early jobs, a special effort was made to get the termination of this work to coincide with all the other activities. By so doing everybody learnt much more about the plant and the items for future maintenance. Moreover, if a major break-down did occur, there was a ready-made record for gauging the probable duration of the shut down. After all, that list on the back of the pantry door is sensible.

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# A NEW TYPE OF CRUCIBLE TILTING FURNACE

A furnace designed by the Morgan Crucible Company, Limited, of Battersea, London, S.W.11, serves the needs of the modern melting shop where plant is required capable of handling medium and large quantities of metal melted under accurate metallurgical control with maximum efficiency and economy. It is designed as a general-purpose melting unit suitable for a variety of uses, including sand foundry work, billet and strip casting, and many of the varied processes in use to-day which involve metal melting. The furnace is compact in design and incorporates various up-to-date features, including hydraulic tilting and a removable body, to ensure labour-saving and trouble-free operation with minimum maintenance and running costs.

The power-tilting system ensures easy and smooth pouring at an infinite variety of pouring speeds and is controlled by the operation of a single valve lever. Tilting is thus brought under exact control and losses due to splashed metal and damage to the furnace and the work being poured by irregular tilting are eliminated.

### Compact Design

The furnace is of sturdy construction designed to withstand heavy foundry usage with minimum maintenance charges. It is compact and the overall size and floor area covered are considerably less than for a hand-tilted unit. The operating points—burner control, tilting control, and platform—are grouped within a minimum height of each other and arranged at a convenient level so that the effort required to run the furnace is reduced to a minimum.

### Power Tilting

Tilting is effected through an oil hydraulic system consisting of a telescopic ram at the back of the furnace, served by a motor-driven pump and small reservoir housed under the furnace platform. Tilting is semi-automatic, simple and foolproof, controlled by the operation of a single valve lever. The lever projects through the platform panel and is spring loaded in the "shut" position, so that when released by the operator during tilting the furnace locks in position. The lever also incorporates push-button control of the pump motor, which is therefore run only when necessary, *i.e.*, when the furnace is tilting up. The operator thus controls the tilting and motoring with one hand by a single lever.

### Multiple Furnace Installations

Special arrangements can be made if desired to run two or three furnaces from a single hydraulic system. The tilting axis passes through the line of the pouring spout so that the furnace gives a fixed pouring stream throughout the tilt. The charge can therefore be poured direct from the furnace without having to move the work, whether it be billet, strip or special mould, or foundry ladle.

The furnace body is made removable so that it can be easily and quickly taken out and changed for a spare one. The tilting shafts lie in open bearings and the body is removed simply by swinging the burner clear of the injector box, disconnecting the ram, and lifting out. This feature is designed to enable the furnace to be kept in continuous production, and to avoid lengthy periods of idleness during which the furnace is shut down for lining and other repairs or replacing the crucible.

The burner is arranged to tilt with the furnace, which can, if desired, be fired whilst in a tilted position. This feature is of particular value in cases where the pouring operation is of a protracted nature, and it is essential to keep the charge up to a definite temperature throughout the pour.

The oil furnace is suitable for all fuel oils and creosote pitch; the gas-fired version is supplied for either town's or producer gas.

### Range and Output

There are four sizes available, ranging from 600 lbs. (brass) to ½-ton (aluminium) capacity. The first three are suitable for the general range of non-ferrous and aluminium alloys, whilst the largest size is limited to aluminium alloys only. The 600-lb. size will also handle special cast irons, and producer-gas firing is suitable for the aluminium alloys only.

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# ROYAL COLLEGE OF CHEMISTRY

## CENTENARY CELEBRATIONS PLANNED

The Imperial College is planning to celebrate next autumn the centenary of the Royal College of Chemistry, from which, through two of its three constituent colleges, it can trace descent.

The Imperial College of Science and Technology, constituted by a Royal Charter dated July 8, 1907, is a federation of three constituent colleges—the Royal College of Science, the Royal School of Mines, and the City and Guilds College (formerly the Central Technical College of the City and Guilds of London Institute). These in turn were related with earlier institutions from which, accordingly, the Imperial College can trace descent. The earliest of all was the Royal College of Chemistry. Its first president was H.R.H. Prince Albert (later the Prince Consort), who had also opened (1851) the Museum of Practical Geology in Jermyn Street, with which de la Beche associated his "Government School of Mines and of Science applied to the Arts." From this source, later, both the Royal School of Mines and the Royal College of Science derived, and the name of the Prince Consort is thus associated with two of the constituent colleges of to-day.

In connection with the centenary celebrations, the Imperial College has recently launched an appeal for funds which, by providing an endowment, will enable it to develop a corporate life more comparable with that of colleges in the older universities.

# METALLURGICAL ASPECTS OF MACHINE-TOOL CASTINGS*

*Meeting the requirements of the engineer*

By J. G. RITCHIE

[ABRIDGED]

The engineer requires clean, sound castings, with particular emphasis on freedom from all defects and good finish on the vital machined wearing surfaces. He further demands a casting which will machine readily and yet will be wear resisting and so maintain accuracy after long periods of heavy service. Furthermore, no movement must occur after final machining, for any such movement will again destroy the accuracy of the machine. The castings must also be strong enough to withstand the heavy stresses imposed at the high cutting speeds necessary with modern cemented carbide tools. As chatter of any kind is one of the greatest enemies of such tools, the machine-tool parts must be rigid and capable of absorbing vibration. It may be of interest to point out that it is in this last respect that welded steel machine-tool frames have proved so inferior to cast iron.

The engineer then presents his design to the foundry, together with the above requirements for soundness, strength, wear resistance and machinability. The required casting is often of complicated shape and with varying sections which introduce considerable shrinkage and contraction problems. The moulder must allow for a camber in his mould so that the casting will come out straight, and for such an allowance to be effective the contraction characteristics of the metal must be uniform. Excessive shrinkage is undesirable because of the difficulty of feeding many of the sections and because of the detrimental porosity which may be encountered in machining deep tee slots—for example in planer tables. Because of the complicated ribbing which is now generally used, and sometimes because of the length of the casting, the foundryman must have metal with good fluidity. If the casting was large, particularly in Australia where most of the foundries have only comparatively small diameter cupolas, the metal may have to be held a considerable time in the ladle before casting. Under such conditions a metal which will "hold" well and will not "go off" is essential.

* A Paper read before a meeting of the Institute of Australian Foundrymen.

The easiest way to consider the structure of grey cast iron is to regard it as a steel in which are embedded flakes of graphite. The structure of the background or steel portion can vary in just the same way as a steel. It can consist completely of ferrite like a dead mild steel, or about 50 per cent. ferrite, 50 per cent. pearlite, similar to a 0.4 per cent. carbon steel, or completely of pearlite as in a 0.8 per cent. carbon steel. The difference in amounts of ferrite and pearlite in the background or matrix will alter the hardness of the cast iron in a very similar manner to that of a steel.

The differences in the mode of occurrence of carbon in cast iron can be determined by chemical analysis, and are expressed as follow:—(1) Graphite carbon (G.C.)—this gives the percentage of carbon occurring as graphite; (2) combined carbon (C.C.)—this is the percentage occurring in the form of the lamellar constituent pearlite or as free cementite, and (3) total carbon (T.C.)—this is the total amount of carbon in the iron, and is equal to the sum of the graphitic carbon and combined carbon contents.

In a white iron the carbon is all in the combined form, while in a grey iron the combined carbon is not above 0.7 per cent., and the remainder of the carbon is as graphite. With over 0.7 per cent. combined carbon, free cementite starts to appear and the iron becomes mottled. A combined carbon figure of about 0.6 to 0.7 per cent. in grey iron represents a completely pearlitic background, and if the figure is lower we know that some ferrite is present.

Coming back to the comparison with steel, Table I shows how the hardness of grey cast iron increases with the combined carbon content in the same way as the hardness of a steel increases with carbon. In each case the hardness is determined by the relative proportions of the soft ferrite and the harder pearlite as shown in Table I.

Just as the hardness of grey iron increases with the proportion of pearlite, so does the wear resistance improve. If the combined carbon rises over 0.7 per cent. and there is free cementite, the iron becomes difficult or impossible to machine. The best strength

TABLE I.—*Brinell Hardness of Steel and Cast Iron in Relation to Carbon Content.*

| | Steel. | | | Cast Iron. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| C | Ferrite. | Pearlite. | BHN* | T.C. | G.C. | C.C. | Ferrite. | Pearlite. | BHN* |
| Per cent. | Per cent. | Per cent. | | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | |
| 0.0 | 100 | Nil | 110 | 3.4 | 3.4 | Nil | 100 | Nil | 110 |
| 0.4 | 50 | 50 | 180 | 3.4 | 3.05 | 0.35 | 50 | 50 | 150 |
| 0.8 | Nil | 100 | 230 | 3.4 | 2.7 | 0.7 | Nil | 100 | 200 |

and hardness, combined with good machinability, is obtained with a structure of graphite and pearlite and a hardness of around 200.

Having considered the effect of the structure of the metallic background, it now remains to consider the other constituent—namely the graphite flakes. Graphite is soft and weak, but has excellent lubricating qualities. The latter quality is of great importance in giving to cast iron its excellent anti-friction properties—as instanced by the fact that two cast-iron surfaces can work in sliding contact, *e.g.*, a saddle on a lathe. As graphite has no strength the flakes naturally weaken the strength of the steel-like background, and the greater the amount of graphite and the longer and larger the flakes the greater will be the reduction of strength. Thus high-tensile strength irons generally show short graphite flakes and low strength irons long flakes, which break up the continuity of the background. The larger flakes, while reducing tensile strength, tend often to improve the wear resistance because of their lubricating and friction reducing properties.

Some confusion may arise over the describing of the type and size of graphite flakes under the microscope. This danger has been largely overcome since the American Society for Testing Materials has published a specification[37] standardising the method of description. This specification gives a series of photographs and the graphite is classified on the basis of type (*i.e.*, method of distribution) and flake size or length.

The strength, hardness and wear-resisting qualities of grey cast iron are controlled by the structure, and there are two main variables in the structure:—(1) The structure of the background, *i.e.*, the relative proportions of ferrite and pearlite; and (2) the size, quantity and mode of distribution of the graphite flakes.

### Effect of Section, Total Carbon and Silicon

The effect of section thickness on the hardness and structure of cast iron is so well known as to need no detailed discussion in this Paper. With any particular iron the hardness generally rises, *i.e.*, the combined-carbon content rises—with decreasing section, and in very light castings care is needed to avoid chilling, which means the formation of white or mottled iron. Thus the combined carbon content is determined to a large extent by the section (*i.e.*, by the cooling rate), and if the desirable wear-resisting structure of all pearlite be sought in, say, a 2-in. section, then the iron will almost certainly chill in very light sections—for example, on fins.

Silicon is present in all cast irons and, with the total carbon, is the most important element in controlling the structure. It is a powerful graphitiser and so reduces chill, and as it is increased, it tends to allow the formation of coarser graphite flakes associated with ferrite (in high total carbon irons). A low silicon content, provided chilling does not occur, helps to keep up the combined carbon content and give a pearlitic structure. The actual silicon content necessary to secure this structure varies with section and the silicon must therefore be adjusted to suit the weight of the casting. With total carbon contents of the order of 3.2 to 3.4 per cent., the silicon generally lies between 1.1 and 1.8 per cent. for heavier machine-tool castings. With the fairly slow cooling rates in such castings, the structure produced should lie in the "grey pearlitic" region of the iron carbon diagram, and would consist of normal flaky graphite in pearlite. The important point is that the composition must be adjusted to secure this structure on the heavy wearing sections and yet prevent chilling on sharp corners or light sections of the actual casting where it would seriously interfere with machinability. With light machine-tool parts the silicon content must generally be higher—in the range 1.8 to 2.5 per cent., depending on section.

With any particular silicon content, the tendency of the iron to chill will increase with decreasing total carbon and decrease with increasing total carbon. Thus a particular section may need 1.3 per cent. silicon to make the iron grey with 3.4 per cent. total carbon, but if the total carbon falls to 2.9 per cent., the silicon may have to be increased to, say, 2.5 per cent. to prevent chilling. It is always necessary, therefore, to consider the total carbon and silicon in conjunction when attempting to predict the structure which will be secured in any particular section. The total carbon and silicon should also be adjusted to ensure that the iron is hypo-eutectic rather than hyper-eutectic.

With normal cupola metal with total carbon of 3.4 to 3.6 per cent., the silicon content largely controls the structure. However, as the total carbon decreases below 3 per cent., the structure is not nearly so sensitive to silicon provided there is enough silicon to keep the iron grey. Generally, if other things are equal, the graphite flakes tend to get coarser as the total carbon increases. As the total carbon content of an iron is decreased, and the silicon adjusted to keep it grey, one would, of course, obtain a reduced volume of graphite flakes, and these tend also to be smaller in size. The result is a general increase in strength as the total carbon is reduced. This is, of course, achieved by using increasing percentages of steel scrap in the cupola charge.

However, as the total carbon content is lowered the solidification point is raised and the freezing range is reduced. This means that for a particular temperature the fluidity is reduced as the total carbon is lowered and the "life" of the metal in the ladle is shorter. With carbon increasing from 2.25 to 3.25 per cent., castability is increased by 30 to 40 per cent., depending on the pouring temperature. It is, therefore, essential to melt low carbon irons very hot and to cast them rapidly. Also low carbon irons shrink more than high carbon and require more feeding and larger feeding heads. As to wear resistance, graphite is a lubricant and therefore increasing carbon content

decreases the rate of wear. If the carbon be too high (with high silicon also), however, the graphite flakes are very large and tear out in machining, giving a poor surface finish with a porous appearance.

### Melting Practice

The first point to consider under this heading is pouring temperature. At high temperatures the fluidity is better, feeding proceeds more satisfactorily and sounder castings are produced. The pouring temperature also influences the structure and the colder an iron is poured, the more likely is undercooling to take place before solidification, with resultant formation of either chilled or fine eutectic graphite structures. On the other hand, superheating prior to pouring increases the tendency to chill. High strength low carbon irons are apparently more sensitive in this respect than the lower strength medium or high carbon irons. It has been proved[11] that castability or fluidity is considerably increased with higher pouring temperatures. It will be readily apparent that in a complicated machine-tool casting, where the metal must run round numerous cores, the iron should be tapped and poured as hot as possible. Tapping temperatures should be over 1,400 deg. C.

To improve the strength of cast irons the basic change is to reduce the total carbon content, this being done by incorporating a percentage of steel scrap in the cupola charge. The lower carbon iron chills more readily, however, than an iron of the same silicon content, but with higher total carbon. This means that in section thicknesses approaching those which would chill, one may obtain the undesirable sooty fracture and eutectic type graphite. Such graphite results in poor mechanical properties irrespective of the low total carbon. Thus the higher chill may move this undesirable structure into vital sections of the casting. If the chill can be reduced, this can be overcome and the supercooled structure confined to very light sections or to fins. This is one of the main objects of inoculation.

It has been known for many years that irons of improved properties could be made by melting a material with a high chill (*i.e.*, low total carbon and perhaps also low silicon) and reducing or eliminating this chill in the ladle by a graphitising addition. Ferro-silicon, calcium silicide, and ferro-silicon and nickel were among the first of such additions used. The explanation was that the additions produced graphite nuclei in the melt and thus assisted in producing the desirable structure of short graphite flakes randomly distributed in the final iron. This process was called inoculating the iron and the additions are generally known as inoculants.

There is a good deal of doubt regarding the graphite nuclei theory and it seems likely that the explanation lies in the effect of inoculants on the dissolved gases. In this connection it is significant that the additions used are generally powerful deoxidisers. Whatever the mechanism, however, there is no doubt of the beneficial effect of inoculation in reducing the possibility of undercooling and in forming well-distributed graphite flakes. For this reason ladle inoculating additions are almost universally used in making high-strength irons and they can be of distinct benefit also in medium-strength metal. The amount of inoculant used is generally small (40 to 120 ozs. per ton), but the effect is out of all proportion to the actual addition. There generally seems to be an optimum addition for securing the best results with any particular inoculant and metal composition.

The small amount of graphitiser added generally has little effect on the stability of the pearlite, so the result is to increase the "grey iron, pearlitic" range of the equilibrium diagram. This means that this desirable structure is secured through a wider range of sections and the iron is less sensitive to section. There is one interesting point regarding inoculation, and that is that its effects are comparatively short lived. The beneficial effects may disappear after 5 to 30 minutes, depending on the type and amount of inoculant, so the iron should be poured within this period. This is one reason why a medium-carbon iron may be preferable to an inoculated lower-carbon iron for heavy machine-tool castings where the metal must be held for a considerable time before pouring.

The number of types of inoculants used, more particularly overseas, is increasing, and some of those used are silicon-aluminium, electrode carbon, aluminium-ferro-silicon, silicon-manganese-zirconium alloy, silicon-calcium-titanium alloy and many others. There is no doubt of the usefulness of such additions in the production of high-strength unalloyed or alloyed iron castings. It should be clearly understood, however, that inoculation is quite distinct from alloying and the two can be used either independently or together. The subject of actual furnace practice is really outside the scope of this Paper, but it should be emphasised that the important point is to standardise the procedure so as to secure uniform structure, strength and contraction characteristics in the iron.

### Damping Capacity

One of the most valuable properties of cast iron is its capacity for damping out and absorbing vibrations. Cast iron is better than any other metallic material in absorbing vibration and some idea of its excellence in this respect can be obtained by comparison with the curve for rubber. This comparison is qualitative only, but it does emphasise the value of this quality of cast iron. Cast iron owes its high damping capacity to the cushioning effect of the numerous soft graphite flakes spread throughout its structure. It follows that the more graphite flakes there are present, the higher will be the damping capacity. This means that the soft and mechanically weak high total carbon irons have higher damping capacity than high-strength irons of low total carbon.

The occurrence of vibration must be avoided at all costs in modern machine tools, as this will cause chatter and consequent wear or chipping of the edge of the cutting tool. This applies particularly to cemented carbide tools, and the point is so important that in many cases cast-iron shanks are being used for such tools. It is largely because of its damping capacity that cast iron is such an eminently suitable

## Machine-tool Castings

material for machine-tool castings, and it is for this reason that it is never likely to be replaced by steel fabricated work.

In considering the effects of the various alloying elements in cast iron on the structure, they can be divided into two classes—those which tend to reduce chill by graphitising cementite and those which increase chill by stabilising cementite. Manganese, chromium and molybdenum increase chill, whilst nickel, copper and silicon do the reverse.

Silicon decreases the chill, but, if it is too high, it will also readily graphitise the iron carbide or cementite of the pearlite. Thus increasing silicon not only makes the iron grey, but, if too high, will tend to soften it rather rapidly. Nickel has also a graphitising influence and reduces chill, but at the same time it tends to stabilise the pearlite, thus avoiding the detrimental influence of high silicon in this connection. The general effect of nickel is therefore to even out the change of hardness and structure with varying section. Increasing silicon in the upper series causes a rapid reduction of chill, but there is a corresponding rapid fall of hardness in the grey iron in the heavier sections. Nickel, on the other hand, reduces the chill, but actually increases the hardness in the grey portions due to its stabilising and refining effect on the pearlite. The use of nickel therefore assists in securing a fully pearlitic matrix in the heavy sections and yet preventing chilling in light sections.

The other class of metals—manganese, molybdenum and particularly chromium—stabilise the pearlite and increase the tendency for free cementite to form, causing chilling. This stabilising effect helps to secure pearlite, and therefore good wear resistance in heavy section. Chromium is particularly effective in improving wear resistance, and for this reason small chromium additions are fairly widely used in machine-tool castings.

It is possible to balance the cementite stabilising and graphitising elements in an iron so that the chilling tendency is not altered by such additions. Table II below, giving relative graphitising values, will indicate how this balancing can be achieved.

TABLE II.—*Graphitising Values of Various Elements in Cast Iron Related to Silicon.*

| Element | Graphitising Value |
|---|---|
| Silicon .. .. | 1.0 |
| Aluminium .. .. | 0.5 |
| Copper .. .. | 0.35 |
| Nickel .. .. | 0.3 to 0.4 |
| Manganese .. .. | −0.25 |
| Molybdenum .. | −0.35 |
| Chromium .. .. | −1.2 |

*Note.*—The negative sign indicates that the element does not graphitise the iron, but increases the chill.

It will be seen that in a nickel-chrome iron, a nickel content of about three times the chromium will not alter the chill of the base iron, and at the same time there will be an improvement in the stability of the pearlite and in wear resistance through varying sections. Similarly, a nickel-molybdenum addition with the two alloys in about the same quantities would not appreciably alter the chilling tendency of the base iron. In some heavy castings there are no light sections and in such cases the addition of chromium only may be helpful in securing the desired density and hardness. Small additions of alloying elements improve the strength and hardness of cast iron, mainly by their influence in stabilising and refining the pearlite. The graphite flake size may be slightly influenced, but the major improvement results from the effect on the structure of the matrix. As the alloying element content is increased, particularly with certain combinations of additions, it is possible completely to alter the structure of the matrix so that it is no longer pearlitic.

The usual high-strength irons are based on a fairly low total carbon content and the aim is to secure short graphite flakes randomly distributed in a completely pearlitic matrix. Such irons are more difficult to handle in the foundry than medium and high total carbon irons. As an alternative to increasing the strength by decreasing the volume of graphite flakes, it has been found possible to alter the structure of the matrix so that it consists of a stronger product than lamellar pearlite. With the addition of nickel and molybdenum—between 1.5 and 2.5 per cent. nickel, 0.7 to 1.5 per cent. molybdenum, depending on section—the matrix will change from pearlite to the acicular type of structure. This acicular structure is a low transformation product of greater strength than lamellar pearlite and actually appears to consist of a mixture of ferrite, bainite, martensite and retained austenite. A definite improvement in strength over the "as-cast" condition can be secured by tempering these acicular irons at about 320 deg. C. for 5 hrs. This treatment seems to transform any retained austenite. There is a definite relationship between section, nickel and molybdenum contents and structure. With heavy sections the alloy content must be increased to maintain an acicular structure rather than pearlite, and in light section work it may need to be reduced to prevent formation of a hard martensitic matrix. The silicon content, as usual, also must be adjusted to suit the section.

The important point with these acicular irons is that it is possible to obtain a tensile strength of the order of 23 to 26 tons per sq. in. with a medium carbon content of, say, 3.2 to 3.4 per cent. Such an iron is much easier to handle in the foundry than one of the same strength, but based on a low total carbon. The nickel and molybdenum are expensive additions, but nevertheless such irons are very useful for small and medium highly stressed machine-tool castings. These irons are also characterised by very good toughness. With lower total carbon some phenomenal tensile strengths have been secured with these nickel-molybdenum irons—up to 32 tons per sq. in. "as-cast" and 45 tons per sq. in. after hardening and tempering.

*(To be continued.)*

[NOTE.—A full bibliography of the works consulted by Mr. Ritchie in summarising this subject will be given at the conclusion of the Paper.—EDITOR.]

# CORRESPONDENCE

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

## HEAT-TREATMENT OF LIGHT ALLOY TEST-BARS

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—I should like to make the following comments on the interesting article by J. Morgan, an abstract of which appeared in your issue dated March 8, 1945.

Under DTD 424, after describing the treatment with a chloride-fluoride flux, the article continues: "Following this, the test-bars, when cast, are subjected to one of two treatments, according to the designer's requirements." The wording of the sentence suggests that only the test-bars are treated. In other words, the bars are given a treatment which is not given to the castings. After the treatment, therefore, their physical properties will be quite different from those of the castings which they are supposed to represent, and they could not be used to release or reject the castings. Probably Mr. Morgan entirely agrees that test-bars should be given no treatment whatever, which is not given also to the castings, but that is not the impression given by the wording of the article.

I have obtained 13 tons per sq. in. after a low temperature treatment of DTD 424, but have not tried the high temperature treatment. The fact that such figures as 17 to 19 tons per sq. in. can be obtained shows what a high quality of material is now being produced by our aluminium alloy refineries, and suggests that it is high time that the term "secondary metal" was dropped.

It is very surprising to see the specification for DTD 304 given as "up to 0.9 per cent. silicon and up to 0.7 per cent. iron." As long ago as May, 1942, this specification was amended to "silicon 0.25 per cent. maximum, iron 0.25 per cent. maximum." If the old specification is worked to, and the iron figures reach the top limit, it is, in my opinion, practically impossible to obtain satisfactory tensile figures constantly. If the metal used conforms to the amended specification, both DTD 298 and DTD 304 figures can be obtained easily. Material is available which is well within the amended specification.

Yours, etc.,

E. CARRINGTON.

29, Stone Grove, Sheffield, 10.
March 10, 1945.

## YOUTH AND THE FOUNDRY INDUSTRY

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—First of all we would like to thank you for the very encouraging Editorial you printed recently on "An Appeal to Youth" arising out of the publication of the booklet by this Association "The Foundry Industry and Your Career."

The letter from Mr. D. J. Thawlis, published in your issue of March 1, is noted with interest. We would like to assure Mr. Thawlis that the Manchester Association is very fully alive to all the problems connected with recruitment into the foundry industry. We have not found it an easy task to get the young apprentices through the foundry doors, and we have found it a very much more difficult task to keep those few who have tried it. The bigger firms we know can cater for the beginner much more easily than is possible in the case of the smaller and medium-sized foundries, which, as your contributor points out, can provide the best training in foundry practice. We are doing our best to show those responsible for the running of the smaller and medium-sized foundries how they can best interest the youths whom they undertake through apprenticeship to train. In several districts we have already got continuation classes running in conjunction with the local education authorities, and we are hoping that next winter other districts within the Manchester Association area will also formulate similar classes.

We are hoping that by the issue of this booklet and others to follow we shall be able to establish a liaison between the industry and the school, which your correspondent rightly states is a vital necessity. We are hoping also that having started this work at the present time the foundry industry, so far as this district is concerned, will get its due share of publicity in the technical training which under the provisions of the new educational arrangements will be general to all boys first of all for a further year, and later until they attain the age of sixteen.

We agree with your correspondent when he writes that the problems and intrinsic value of the trade are attractions enough. We have stressed in our booklet the great variety of the work, and the jobbing foundry owner cannot too frequently emphasise to his young worker the constant challenge that the day-by-day problems offer to the intelligent workman.

Yours, etc.,

WEBB AND HALL,
Secretaries.

Manchester and District Ironfounders' Employers' Association.
90, Deansgate, Manchester, 3.
March 8, 1945.

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ACCORDING TO Mr. Lester V. Colwell, writing in "Metal Progress," the production of centrifugal castings is being limited by the lack of special equipment, except where very large quantities are required.

AT THE MARCH MEETING of the Slough Section of the London Branch of the Institute of British Foundrymen, Mr. Adam Dunlop, of the Aston Chain & Hook Company, Limited, repeated his Paper, originally given in Birmingham, "Precision Casting by the Lost-wax Process."

THE "NICKEL BULLETIN" for February contains abstracts dealing with the preparation of metal carbides, creep resistance of nickel-containing, heat-resisting alloys, properties of austenitic weld metal and nitriding austenitic steel valves. Copies may be obtained, free of charge, from the Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

# THE SCOPE AND LIMITATIONS OF RADIANT HEATING IN DRYING PROCESSES

By H. SILMAN, B.Sc., F.R.I.C., A.M.I.Chem.E.

*Discussion on a Paper read before the annual conference of the Institute of Vitreous Enamellers held recently at Manchester. Mr. J. W. Gardom, President of the Institute, occupied the chair. The Paper was printed in our issues of March 8 and 15.*

The CHAIRMAN said the conference was much indebted to Mr. Silman for his very able survey of the infra-red field of inquiry. Speaking as one who had used the G.E.C. plant, he could endorse most of the observations which had been made. It was found that the main damage, or loss of bulbs, was due to the fact that they had to be removed once a week in order to clean the reflectors, and that it was a hard-fisted type of labourer who damaged most of them.

MR. SWINDIN asked whether the rhodium reflectors had been installed.

MR. SILMAN replied that they had been installed by the G.E.C., and had been most successful.

MR. BRADBURY thought the Paper was a most controversial one. A point had occurred to him in connection with the drying of flat sheet. In convection ovens it was possible to load the flat sheets too closely together, say, at distances of 1 in. or 1¼ in. Could the work be carried out by means of the infra-red oven, or was it necessary to dry the sheets flat, and, if it was necessary, was the space due to the very light loading such that the length of the oven would be increased rather than decreased, even taking into account the shorter drying period which was necessary?

MR. SILMAN said an important point had been raised. In a convection oven, if it was intended to treat sheets, they could be packed very closely, and a very high load be obtained. In the case of a radiant oven, both sides had to be exposed to the surfaces, so that there had to be a very long narrow tunnel. If the work had to be done at a reasonable speed, the tunnel had to be of tremendous length for the reason that the sheets had to move through extremely slowly. This was one of the cases, because of the high loading of sheets, it was better done in a convection oven.

The firm with which Mr. Bradbury was associated had made some excellent convection ovens for doing this type of work, and it seemed to be quite certain that radiant energy could not compete for the type of job.

### Gas Fire Radiant Equipment

MR. ATKINS wished to speak more particularly with reference to the gas-fire equipment for radiant heat. Mr. Silman had mentioned the effect of colour. With either gas or electric light that effect was not so pronounced as might be thought, taking into account the curves which had been shown. The chief factor affecting radiation was the emissivity of the source and the emissivity of the receiver. There was very little difference between the emissivities of the different colours. There were variations from 0.2 for a polished sheet to, possibly, 0.9 for a roughened sheet or cast iron; but, as far as painting was concerned, all emissivities were of the order of 0.9.

It might be of interest to state that an experimental job had been done with vitreous enamel prior to drying. He did not know whether he was using correct terminology, but he thought it might be called wet-spraying. It was an electric bulb of some 15-in. dia., which was wet-sprayed and dried in a gas-fired oven with a panel temperature of 600 deg. F. It was completely dried in 1 min. 45 secs., being subsequently fired. The firm concerned said it proved to be quite satisfactory; in fact, so much so that they said, as far as they were concerned, they had finished with stationary ovens.

There were two essentials for the correct application of radiant heat, whether it be by electricity or by gas. In the first place, the conveyors must be in a single line; radiant heat would not permit of any shadowing. Secondly, all the parts going through the oven must be of the same section, not necessarily the same shape, provided the thickness of the metal was not varied. It would not be practicable to make a load of 16-gauge sheet iron and a small light casting. Whereas, for instance, the enamel reflector took 1 min. 45 secs., if it were cast iron, it would probably take minutes. It was possible, of course, to use the same conveyor, and use the same speed, and vary the intensity of heating by turning down the gas.

### Application to Vitreous Enamelling

MR. RYDER said that the limitations mentioned by Mr. Atkins about preparing the gauge and thickness were not so important when drying vitreous enamels as in drying paint. When drying paint, it would tend to spoil and this did not occur in drying vitreous enamels. He had done a certain amount of work on one of the Andrew and Chamberlain units, and it was found afterwards that there was no sign of crazing or of the enamel lifting or anything else.

MR. SILMAN wished to point out that, with radiant energy, the energy should, from the point of view of economy, be directed as much as possible on to the work. If there were light-gauge metal and heavy-gauge metal dealt with simultaneously, in the case of enamels it would not matter very much whether the light-gauge metal was subjected to the radiation too long. On the other hand, the fact that the metal would have to be subjected to an unnecessarily long period, while heating-up would tend to make the costs high and also tend to make the plant unwieldy. It had been one of the disadvantages of the electric plant that the amount of energy utilised was very large. In the case of some of the slides shown, the loadings were 7 or 8 kw. for quite small plant. The electricity people seemed to be very proud of this, but it was nothing to be proud of at all.

The CHAIRMAN then invited the members of the conference to send further written questions or remarks for future reply by Mr. Silman, and the discussion closed with a vote of thanks to the Author for his Paper.

# USES OF GASES IN THE FOUNDRY

By HAROLD HAYNES

*Discussion of a Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. A. Hopwood, Branch-President, being in the chair. The Paper was printed in our last issue.*

### Vote of Thanks

MR. R. S. YEOMANS (Manchester), in proposing a vote of thanks, said that the Lecturer was recognised for the practical manner with which he dealt with foundry problems. Gas was extremely useful in the foundry, and probably, in the future, its use would be extended. Perhaps the only thing which some of them might object to in regard to it was that the appliances became dirty, and, if not kept clean, were apt to become inefficient. However, this was merely a matter of maintenance. A further consideration was, unless there was sufficient ventilation, the same objection could be raised as with other fuels, such as coke.

MR. A. E. DAVIES seconded the vote of thanks. He had used a considerable quantity of producer gas himself, though not necessarily in the foundry, but in the various shops associated with it. Everybody would probably bear it in mind that producer gas would be dangerous, and with its use a considerable amount of water formed in the pipes. It had been found to be an advantage to have the pipes leaning down from the source of supply, so that the water could be easily tapped off when necessary.

One of the difficulties with which he had been confronted—probably Mr. Haynes could give him some advice on the point—was that, if a burner was not used for, say, a couple of weeks, and it was necessary to open the tap here, difficulty occurred in doing so. He had had to cut out brass taps and use cast-iron ones of a special type. When the tap had not been used for about a fortnight, it was almost impossible to use it unless the gland was taken out and the tap knocked right out. He would also be pleased to learn what arrangement Mr. Haynes made with regard to the burner for the torch; whether there was just a clear outlet of the gas, or whether some injector method was adopted in order to secure a more efficient form.

The vote of thanks was carried unanimously by acclamation.

MR. H. HAYNES, in reply, referred to the case of the gas being so dirty that it could not flow through the jet, apparently the questioner was thinking about an accumulation of tar filling the pipes. His firm had been using gas pipes for the past 26 years. No special care was taken of them by the men; yet they were still entirely satisfactory. The flame came from a plain 1-in. pipe. There was no appearance of either tar or water or any other deleterious substance. The producer gas came from a purifier, and was boosted, imparting extra force to the gas for drying purposes. Ordinary gas pipes drilled with holes were used. Bituminous coal was used in the producers.

### Discussion

MR. A. E. DAVIES said he used anthracite. The plant was especially designed for japanning stoves and various other industrial appliances. Quite an appreciable amount of difficulty had been encountered and it had been found necessary to clean out the pipes regularly. Another point was that ample cold water must be used in order to keep the temperature low in the scrubber, otherwise the moisture of condensation was carried over into the pipes beyond the booster so that the water settled out. Perhaps the anthracite caused the trouble, although there did not appear to be any good reason why it should when the gas was scrubbed and passed through the purifier.

### Relative Costs

MR. A. SUTCLIFFE (Bolton) asked how the plant stood on the score of expense, and how gas heating compared with coke-firing for mould drying on a large scale.

MR. HAYNES replied that he had been using gas for 40 years and had proved it to be very satisfactory. He had experienced no trouble whatever. It was best perhaps to see the method in operation, and in the near future his directors would like the Lancashire Branch to visit the works.

### Possibilities of Town's Gas

MR. HOWELL (Manchester Corporation Gas Department) was interested in the ingenious way in which Mr. Haynes applied gas for his own purposes as well as by the simplicity of the methods adopted. All the operations which had been described by the Lecturer could be done just as well with town's gas as with producer gas; it was merely a question of price; at 5½d. per therm all coal-gas undertakings could compete, as well as take out all the tar, sulphur, and other objectionable products.

Many of the applications which had been mentioned had been effected in foundries by means of town's gas. Cupola lighting with coal gas was popular now, and particularly so owing to the shortage of wood. With a gas/air-blast burner in a cupola, it could be lighted within 15 to 20 min. of putting on the gas. Skin drying of moulds had been done by means of town's gas and a torch. Core drying had been done successfully at quite a good price. Core dryers were usually fitted with an automatic equipment so that constant temperature was maintained, and the cores came out evenly baked all the time.

Ladle drying had been done on 40- to 60-ton capacity vessels in a steelworks as well as with small ladles in ironfoundries. It was found preferable to invert the ladle over the burner, where possible. The use of coal gas in a brassfoundry depended upon the price. The melting of brass could be done quite successfully and there was a longer life of crucibles. Further uses for town's gas were the annealing of castings, vitreous enamelling, and space heating. Suitable applications for the use of town's gas were innumerable and tended to create an improvement in the quality of the surrounding atmosphere as well as effecting a perfect control over the production of the required article.

## Uses of Gases In the Foundry

MR. W. POTTS (Manchester) thought that gas drying of moulds in the floor was one of the best applications. Coke fires were now obsolete for this purpose. When endeavouring to repair broken cores or broken moulds, great difficulty was experienced in the use of a coke fire, whereas, with gas, moulds could be dried without any burning in any particular spot. A mould could be dried right through in a night. No attendance was required at night; the gas was turned on and ignited, and by morning the mould was perfectly dry. As a rule, he did not cast during the day, but through the night. He used town's gas, although it was slightly dearer, but the cleanliness of the mould and the excellent drying obtained were sufficient compensation for the extra price.

### Cupola Lighting

MR. A. L. KEY (Manchester), referring to the lighting of the cupola, said the object could be achieved in exactly the same way without any special devices. If, in putting in the bed, a small tunnel was left from the base, about 9 in. from the wall, then the gas pipe inserted and the gas turned on, then in 10 min. or a quarter of an hour exactly the same operation had been completed as was done with the apparatus described in the Paper. There was no loam cake to be put in and no sealing to be done.

MR. HAYNES said it was found that the new method was better, as it burnt the bed more even. The apparatus was not costly, consisting merely of two castings, and it would last a lifetime.

MR. J. MASTERS, JUN. (Shrewsbury) asked as to the ratio of air compared with the gas for the furnace igniter.

MR. HAYNES said there was the ordinary valve with a ¼-in. pipe. After the gas had been burning about 10 min. it was shut off and air was turned on to do the remainder.

MR. MASTERS, JUN., said that, where the air pressure had been greater than the gas pressure, he had noticed the air pressure going back into the gas main, and a considerable amount of trouble ensued. Had Mr. Haynes had any similar experience?

MR. HAYNES replied that he had not.

MR. A. E. DAVIES (Newton-le-Willows) said that in the case of his apparatus 4 in. of mercury was used, which he understood to be about 2-lb. pressure per sq. in. There was not 2-lb. pressure per sq. in. in a cupola, so that there would not be much likelihood of the air pressure blowing back into the pipes.

### Mould Drying in situ

MR. J. MASTERS, SEN., said that, as to the drying of moulds on the site, he had in mind one case where 80 castings of one type were made per day. If the firm had had to stove them, etc., it would have meant crane power in loading and involve about twice the amount of time in production. To surmount the difficulty of loading and stoving, the foundry management designed a burner using town's gas. The burner was designed to follow, more or less, the contour of the mould. When the gas was burnt, the burner just acted as a heater. Once the burner was hot, it never went cold again all day. The moulds were dried in 27 min. and an excellent job secured. In the case of the particular type of mould in question, the section, in some places, was not more than $\frac{7}{8}$ in. in cast iron, while in other parts it was 1¼ in. of metal used. There was rarely a scrap casting nor a scab.

### Portable Hot-air Stoves

The PRESIDENT remarked he had not heard anyone speaking about the hot-air dryer. Had anyone experience of the cost?

MR. MASTERS, SEN., said that hot-air systems had been patented by several firms, and much depended upon the class of work to be done. Personally, he would not try one. There would be difficulties connected with deep moulds. There was a difficulty in getting the heat to go down; but with the gas dryers it was possible to place the burners at the bottom of the job.

MR. KEY said it depended upon the job to be done. A small portable dryer would consume about 43 lbs. of coke per hr., and the next size of dryer would burn 73 lbs. per hr. It was merely a matter of comparing the cost of 43 or 73 lbs. of coke with the cost of the gas, of course, taking the time factor into account.

MR. F. ANDREWS (Failsworth) noticed that Mr. Haynes was not using gas in his larger mould stoves.

### Publicity Lacking

When speaking about hot air, surely the hot-air dryer was a gas producer. The portable dryer was an automatic stoker applied to a stove; it was making a gas producer of the firebox. It seemed to him that Mr. Haynes should have developed his method upon the lines of using gas for drying his large cores. Why had he not done so? A foundry which was not very well manipulated when using coal, or even coke, produced much soot, which represented money. If the soot could be eliminated, there could be efficient combustion. From what had been said that afternoon, it appeared as though the salesmen from municipal gas departments should journey round and advertise their wares a little more to foundry concerns.

MR. HAYNES said there was no doubt about it that the gas undertakings generally had been somewhat remiss in not attempting to cater for foundry people to a far greater extent than they had done in the past—with either town's gas or producer gas. He had worked in 14 foundries, seven of which used gas, and therefore he understood the experience of using gas from a moulder's point of view. His advice was that it was worth while for any foundry to have either town's gas or producer gas. In a very large foundry, such as the one with which he was associated, there were certain times when coke fires and coke stoves had to be used. Cores totalling 2 tons in weight were dealt with, so that cost had to be considered sometimes as to which was the best method to adopt.

### Depreciation Factors

MR. SUTCLIFFE inquired what was the cost of the depreciation of the apparatus.

MR. HAYNES said that nowadays a producer plant cost £330, and if the labour of one man was saved for 8½ hrs. per day out of five men, it would soon pay for the cost of the plant. The saving effect would be equivalent to £250 per annum. In 1938 the plant cost £298.

MR. A. E. DAVIES had used an electric radiator on phosphor-bronze castings with very good results. It was a method which originated in green sand. He had never heard of an electric stove being used for core drying.

MR. R. S. YEOMANS asked whether any efficient means of works space heating had been evolved by using gas. Mr. Sutcliffe had referred to electric stoves, but electrical heating had progressed much further. It was used in foundries in a similar manner to that illustrated by Mr. Haynes in his lecture, namely, drying moulds in boxes and on the floor. The only drawback appeared to be the cost, but in countries where electric power was cheap it had been so used.

MR. J. MASTERS, JUN., said he had visited several foundries where overhead radiant heating was adopted for the general comfort of the actual worker. The radiants were suspended from the ceiling, and, roughly, about 15 ft. from the floor. It was found that, by this arrangement, there were few spaces in the room which were not subjected to the heat from the radiants.

MR. J. MASTERS, SEN., said the application of radiant heating to drying moulds could be effected either by electricity or by gas, though the method was still in its infancy. There could be, also, the application of radiant heat through the medium of the infra red rays in regard to the skin drying of moulds. Radiant heat by means of a torch had to be applied evenly, but much depended upon the shape of the mould as to whether it would be a practical proposition, or whether it would be better done by a hot-air drying unit supplied by gas.

MR. C. R. VAN DER BEN stated that his first experience of the use of gas in a foundry convinced him that it had many advantages. He was fully in accord with all Mr. Haynes had said on the score of convenience and simplicity; the method worked very satisfactorily. With regard to the point raised by Mr. Masters concerning skin drying, obviously much time would be saved. In answer to Mr. Sutcliffe, the price of 5½d. per therm for gas included 10 per cent. depreciation of plant, and it might be stated, for the benefit of the gas undertakings, the gas actually used did not cost anything like that figure. The foundry had the advantage of drawing the gas from a large producer plant using bituminous coal, so that there were by-products in the form of tar, ammonia, etc. The cost would be considerable in the case of a small unit, but with a large plant the 5½d. figure could be comfortably halved even at the present day. In that respect, he should imagine the method was rather out of line possibly with the use of town's gas. However, be that as it may, for small undertakings town's gas was definitely a proposition for consideration. At the same time, the coke-fired producer did not introduce any difficulty due to the separation of the tar or by the deposition of soot in the mains.

MR. F. A. ANDREWS said he had had experience of using electricity for heating stoves. He had had two stoves which had been previously used as gas stoves for sheet metal work. The arrangement was that there was a space below the floor about 1 ft. deep in which there were placed a number of resistances. The correct temperature could be obtained, but the cost was a serious factor. Ultimately, four were built instead of two, or rather, he should say, one continuous stove the same size as the steel ones, with another couple of doors. The other stove was scrapped. A flue was taken from the large main flue, and satisfactory results were obtained. The electric method was too expensive and was abandoned.

MR. A. L. KEY enquired what was the relative cost of very large stoves using producer gas as a firing medium compared with present day coke-fired stoves. He thought it was in 1940 when the works were visited, and he believed the large stoves were gas-fired.

MR. HAYNES said they were not in his time.

MR. VAN DER BEN could not confirm Mr. Key's statement.

MR. KEY thought he could visualise a stove with the burners round.

MR. HAYNES said that everything had been transformed and reorganised.

### Making Up Hand Holes

The PRESIDENT remarked that it was obvious the older members of the Branch, at any rate, had thoroughly enjoyed the lecture. Mr. Haynes had rapidly glossed over one point with great skill and ingenuity. He spoke about making up his hand holes. There were a very large number to make up, and every moulder had a different way of doing it. If a man was told to do it one way, he would do it another. Some moulders could make up hand holes while others could not; it all depended upon the planning. It was going on the right track to convey the fuel to the job, but the point was whether a multiplicity of attachments, tubes and burners, etc., would be required for different types of castings. In the case of a regular output of a certain type of casting, or a large war contract, there was nothing to stop anyone from making any amount of planning which was considered to be necessary, and probably it could be done to ensure a profit.

MR. HAYNES said that where there were eight main cores with two bolt-hole cores in, 4 in. square, they were filled up with ashes and half facing sand and half baked sand. If this were not done, and the air had to strike through the bottom of the mould and out at the bottom, then, if it came back, it would blow-off from the top of the mould. There would be a scab and a bad casting.

The PRESIDENT said sprigging did not stop the face of the sand from lifting. Mr. Haynes had explained the position very concisely in accordance with what was believed to be the correct practice. Nevertheless, it was found that many men who had a hand hole to

## Uses of Gases in the Foundry

make up just pasted in some sticky material under the impression that they were making a good job. This was quite a wrong way of carrying out a simple operation.

MR. J. MASTERS, SEN., referring to the large columns, asked if the gas burners were placed at the bottom.

MR. HAYNES said they were placed 9 in. from the bottom and 9 in. from the side. The booster was very efficient in giving a "kick" to the gas.

MR. J. MASTERS, SEN., mentioned the hot-air units. If the pipe was to be held right down to the base of the mould and the heat rose outwards, it could not be done without an auxiliary booster.

MR. J. JACKSON (Accrington) thought Mr. Haynes had very clearly demonstrated the advantage of using gas in moulding practice. He had found, in the case of a jobbing foundry, the application of gas to normalising and annealing was remarkable and successful owing to the readiness with which burners could be adjusted at any particular point requiring heat. It did not matter what shape of stove was used; a practical even temperature could be ensured whether at the back or in the centre of the stove. He was convinced a similar success could be achieved in regard to moulds. If a definite, regular temperature could be attained with gas, then he was quite sure it could be a good service in the foundry. Mr. Haynes had presented one of the most practical Papers to which the Branch had ever listened.

MR. D. FLEMING (Manchester) spoke as one who had been privileged to visit the foundry which Mr. Haynes was connected with, and had seen some of the work done there. It was not merely Mr. Haynes' enthusiasm for the use of gas which caused him to keep on using it, but the really good quality of the work which was being turned out. Its most modern competitor was electrical heating, using the infra red rays, but for general jobbing works gas was suitable in most cases. If the infra red methods were used, then, apparently, the heaters had to be fairly closely shaped to the particular surface to which the heat was being applied. Possibly for the skin drying of moulds there might come a day when all that was necessary to be done was to turn on a switch, but at the present time Mr. Haynes had made out a very good case for the gas heater.

The proceedings then concluded.

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A LETTER HAS BEEN RECEIVED from Mr. Paul Ropsy, one of the founders of the International Committee of Foundry Technical Institutes. A notable past-president of the Belgian Foundrymen's Association, he was a frequent visitor to this country. At his works at Merxhem, near Antwerp, where a variety of chilled-iron castings was made, he was often host to parties of British foundrymen. His address is now 19A, Avenue Marnix, Brussels.

## THE LONGDEN CUP

Mr. John Longden, of Clydebank, has achieved the unique. He has designed, modelled, made and presented (by request) the cup which we illustrate below to the Clydebank Municipal Golf Club. The cup is of bronze mounted on a planetree wood plinth carrying a black cellulose finish. It stands 10½ in. high on a base 2½ in. deep. Mr. Longden, who is on the foundry staff of D. & J. Tullis, Limited, Kilbowie Ironworks, Clydebank, has a statue called "The Runner" in the Glasgow Art Gallery.

THE LONGDEN CUP.

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OVERHEARD IN A Victoria Street luncheon club much frequented by engineers: "It isn't our customers we entertain nowadays—it's our suppliers."

OF GREAT USE to engineers is a process developed by the Eastman Kodak Company, which permits of the direct printing of blue prints on to metal surfaces, provided they are free from grease and dirt. The surfaces are first sprayed with a rapid drying layout paint and then printed as is usual under an arc or mercury vapour lamp.

# ORGANISATION OF THE IRON AND STEEL INDUSTRY

The British Iron and Steel Federation, which was a reconstitution of the National Federation of Iron and Steel Manufacturers, was formed in April, 1934. The provisions of its constitution were discussed before their adoption with the Import Duties Advisory Committee, who agreed that the proposed organisation was in conformity with the establishment of an efficient iron and steel industry. In order to meet the conditions expected after the war, certain modifications in the present organisation are necessary. A new constitution has, therefore, been drawn up by the Executive Committee of the Iron and Steel Federation. The guiding principles are these:—

(1) As a basic supplying industry, to render efficient service to the community.

(2) Self-government within the framework of Government policy.

(3) To develop the industry in all its branches to the greatest possible extent, particularly for export, not only of its own products, but also of other industries using its products; and to maintain full and regular employment.

(4) To ensure that reasonable and steady rewards are paid to the labour employed and to the savings invested in the industry.

(5) The industry, being a highly complex one, must have an organisation which will ensure that while it is united for common purposes, the management is sufficiently decentralised to give full play to enterprise and initiative. The organisation must be the servant of the industry, and not its master.

(6) To set up an executive body properly representative of all sections of the industry, elected in such a manner as to ensure that the best men get to the top.

(7) To set up machinery which will provide for constant survey, planning and investigation within the industry,

### Membership Confined to Associations

At present the members of the Federation consist partly of Associations, regional representatives and individual firms. It is proposed that in future full membership should be confined to the organisations set up by the various sections of the industry. In other words, membership of the Federation will be confined to Associations, or, as they are termed in the new constitution, "Conferences."

Except as regards matters of general policy and national or common interest, the Conferences will be free to manage their own affairs. It is essential that such a provision should be made, because the industry is so diverse that efficiency and initiative would be impaired by any form of centralised control, except upon matters of general policy and common interest.

The Conferences in the particular form envisaged do not exist at present. Time will, consequently, be required for their formation, or for the adaptation of existing Associations. While complete freedom will be given to the various Conferences to organise their particular section of the industry, in such a manner as may seem to them to be the most appropriate, certain definite clauses in their individual constitutions must be common to all, so that the industry as a whole may be enabled to attain its objectives.

### Representation on Council

The Federation will be governed by a Council and an Executive Committee. Each Conference will be represented on the Council in proportion to its relative importance, and, in addition, due weight will be given to the complexity of each section of the trade within the Conference, with the object of ensuring that the Council as a whole is a truly representative body. The Executive Committee will be chosen from the members of the Council, with the proviso that each Conference must be represented.

The status of the members, both of the Council and of the Executive Committee, is defined so as to ensure that these bodies will consist solely of persons directly responsible for management in their own companies. Provision is also made for the appointment of additional individuals of outstanding personality to the Council and the Executive Committee.

The Executive Committee will thus not only consist of the leaders of the industry, with power to act, but these leaders will have been elected democratically by the various sections of the industry.

There will be a chief executive officer of the Federation, chosen from outside the industry, who will act as chairman of the Executive Committee. Apart from his executive duties in putting into practice the general policy of the industry as the Executive Committee may from time to time determine, he will act as impartial adviser to the Conferences and to individual firms as may be required.

Provision is made for appeal to an independent tribunal by any Conference or any firm.

There is also provision whereby any Association within the United Kingdom which is directly or

## Iron and Steel Industry

indirectly concerned with the industry, can become an affiliated member of the Federation. Similarly, provision is made for affiliation of the iron and steel manufacturers in the Dominions.

Various standing Committees are set up under the ægis of the Executive Committee, among which are the Economic Efficiency Committee and the Price Policy Committee. The former will be responsible for ensuring that the technical efficiency of the industry is maintained; its functions will be not only to advise on proposed schemes of expansion or reconstruction, but to make a survey of each of the main sections of the industry, and actively to stimulate modernisation when and if necessary.

### Price Policy

In connection with the functions of the Price Policy Committee, it is stated that the industry would welcome in the post-war era the setting up by the Government of a tribunal such as the Import Duties Advisory Committee, to examine the costs of the industry in relation to selling prices. The general policy of the industry as regards selling prices is that they should be based upon the costs of economically efficient plants, and that it should be accepted as a fundamental principle that such plants are enabled not only to obtain a reasonable return on the capital invested, but also to set aside a sufficient amount towards research and development.

The new Constitution is designed to promote maximum efficiency; give full play to enterprise; and at the same time avoid the stifling of initiative by dictation or bureaucratic control.

## PUBLICATION RECEIVED

**The Maintenance of Industrial Boiler Plant.** Published as Fuel Efficiency Bulletin No. 38 by the Ministry of Fuel and Power, 2, Little Smith Street, London, S.W.1. Free to our readers on application.

The principal contents of this pamphlet are:—Causes of low boiler efficiency; workshop and equipment; exclusion of air leakages; cleaning of boiler surfaces; preventing and short-circuiting of flue-gases; lagging and insulation; pumps; fans; steam jet forced draft furnaces; mechanical stokers; types of packing and jointing; starting up and shutting down boilers, and how to assess the thermal efficiency of the plant.

DURING THEIR RECENT VISIT to Lancashire, the King and Queen toured the Pagefield Ironworks of Walker Bros. (Wigan), Limited. They went through various departments and the Queen stopped to talk with a number of workers.

## FORTHCOMING EVENTS

*(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)*

MARCH 24.

*Sheffield Metallurgical Association*:—Joint meeting with the South Yorkshire Section of the Royal Institute of Chemistry. "The Principles Governing Corrosion Resistance in Metals and Alloys," by Dr. U. R. Evans. At the Sheffield Metallurgical Club, 198, West Street, Sheffield, 1, at 2.30 p.m.

APRIL 12.

*Institute of Metals*:—Joint meeting between the London Local Section and the London Section of the Society of Chemical Industry. At the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, at 7 p.m.

APRIL 20.

*Keighley Association of Engineers*:—"Recent Developments in Powder Metallurgy," by Dr. Rowell (Imperial Chemical Industries, Limited). At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

### Institute of British Foundrymen

MARCH 24.

*Birmingham Branch*:—"Malleable Cast Iron," by A. E. Peace. At the James Watt Institute, Great Charles Street, Birmingham, at 2.30 p.m.

*East Midlands Branch*:—Annual meeting. Short Paper Competition. At the Technical College, Derby, at 6 p.m.

MARCH 26.

*Sheffield Branch*:—Joint meeting with the Iron and Steel Institute. Discussion of the Report of the Foundry Practice Sub-Committee. At the Royal Victoria Hotel, Sheffield, at 7 p.m.

MARCH 28.

*London Branch*:—"Gating, Risering and Chilling of Magnesium Castings," by A. Cristello. Exchange Paper from the Metropolitan Chapter of the American Foundrymen's Association. At the Charing Cross Hotel, London, W.C.2, at 7.30 p.m.

APRIL 7.

*Bristol and West of England Branch*:—Annual general meeting and whist drive.

*Wales and Monmouth Branch*:—Works visit to the Tubal Cain Foundry and Engineering Works, Limited, Cardiff, at 2.45 p.m. Followed by a lecture at the works on "Phosphor-bronze Worm Wheel Blanks," by A. Hopwood.

APRIL 14.

*Bristol and West of England Branch*:—"Plaster and Plastic Patternmaking and Low Melting Point Metals," by H. Plucknett. At the Technical College, Brunswick Road, Gloucester, at 3 p.m.

## IRONFOUNDERS' NATIONAL CONFEDERATION

At the fifth annual general meeting of the Ironfounders' National Confederation, held recently in London, the following office-bearers were appointed for the current year:—Chairman, Mr. A. E. Pearce (Midland Motor Cylinder Company, Limited, Smethwick); vice-chairman, Mr. Graham Bissett (Enfield Foundry Company, Limited, Waltham Cross); Council: Mr. G. W. Allott (Newton, Chambers & Company, Limited, Sheffield), Mr. J. E. V. Jobson (Qualcast, Limited, Derby), Mr. G. A. Ure, J.P. (Smith & Wellstood, Limited, Bonnybridge).

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**IF YOU WANT...**
***clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify***
***STANTON MACHINE CAST PIG IRON***

SPECIFICATION

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| WEIGHT | 80-90 lbs. |
| Length | 22 inches |
| Width | 8½ inches |
| Thickness | 3¾ inches |

(at notch 2½ inches).

***Made in our well-known***

**STANTON, HOLWELL & RIXONS BRANDS**

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

## PERSONAL

MR. R. E. FORDHAM has been elected a director of Lightalloys, Limited.

MR. R. GRESHAM COOKE, secretary of the United Steel Companies, Limited, has been elected to serve on Sheffield University Council.

MR. A. G. GUTHRIE and MR. R. P. WILLCOX have been appointed directors of J. & E. Hall, Limited, engineers and ironfounders, of Dartford, Kent. Both have been connected with the company for many years.

MR. J. N. ALDINGTON, B.Sc., has been awarded the degree of Ph.D.(External) by the University of London for a thesis on "The High Current Density Mercury Vapour Arc." Dr. Aldington is assistant works manager and head of the laboratories of Siemens Electric Lamps & Supplies, Limited, Preston, and has played a leading part in research work and development in the field of electric lamps during the past decade.

MR. H. W. CREMER has resigned from his position of Director of Chemical Engineering Studies in the University of London, King's College, and is now senior chemical engineer with Sir Alexander Gibb & Partners, with whom he has been working throughout the war on the design and construction of various Government works connected with the war effort. Mr. Cremer is a past-chairman of the Chemical Engineering Group of the Society of Chemical Industry and present honorary treasurer of the Institution of Chemical Engineers.

MR. HARRY LANE has been reappointed to the board of Heenan, Beddow & Sturmey, Limited, structural engineers, of Newton Heath, Manchester, as managing director. In 1943, by agreement, he retired from the board. He was managing director under service agreements due to expire on January 18, 1944. The chairman's statement in May, 1943, intimated that the compensation of £15,000 to be given to Mr. Lane for loss of office might well prove "considerably less than the income he would receive if the agreements were allowed to remain in force for their full term." The £15,000 and certain shares were devoted to the elimination of a debt due by Mr. Lane to the company.

### Wills

| | |
|---|---|
| TREGLOWN, H. T., of Wembley, a director of Burnell & Company, Limited, steel sheet rollers and galvanisers, of Ellesmere Port, Wirral, Cheshire | £18,792 |
| SWAN, SIR CHARLES SHERITON, chairman of Swan, Hunter & Wigham Richardson, Limited, and a director of Sir W. G. Armstrong Whitworth & Company (Shipbuilders), Limited, Glasgow Steel & Iron Company, Limited, and Wallsend Slipway & Engineering Company, Limited ... | £224,809 |

NINETY-EIGHT long-service awards, including five for 50 years' service, were presented on March 10 to employees of Joseph Sankey & Sons, Limited, sheet-metal workers, etc., of Bilston. Mr. W. Van Helden, director and general manager of the Albert Street works, received an award for 20 years' service.

## NEWS IN BRIEF

A MEETING OF Lancashire Dynamo & Crypto, Limited, is to be held on April 4, to consider a resolution providing for the adoption of amended articles of association. The main feature of the proposals is the insertion of clauses permitting the conversion of the company's shares into stock.

AT THE PRESENT TIME more than 85 per cent. of China's iron-ore reserves is in regions either occupied, invaded or penetrated by the Japanese. China's iron and steel capacity exclusive of Manchuria, says the "Iron Age," is believed to be about 140,000 tons of pig-iron annually and about 10,000 net tons (2,000 lbs.) of steel annually.

THE ENGINEERING INDUSTRIES ASSOCIATION is investigating the possibility of adding the resources of the engineering industry to those of the building industry in order to ensure adequate progress with the nation's housing programme. Lord Davidson, president of the Association, has suggested a partnership between building and engineering.

BIRMINGHAM ELECTRIC FURNACES, LIMITED, have decided to change their name to Birlec, Limited. Their trade mark "Birlec" has been established for many years, and it is felt they are already more widely known by this shortened title. The company is a subsiduary of the Mond Nickel Company, Limited. The policy and management will not be affected by the change.

## CONTROL OF MELTING REACTIONS

The control of melting reactions in the direction of the highest possible recovery of alloying elements, says J. S. MARSH, Bethlehem Steel Company, writing in "Steel," was of special importance during the days of critical shortages; much was accomplished by way of conserving stocks of virgin materials through careful selection and segregation of alloy scrap and through controlled melting. Controlled melting presupposes knowledge of the reactions of the alloying elements in the presence of steel and slag. Data prove that the behaviour of the oxidisable elements, such as chromium, manganese, and phosphorus is similar: high residuals are favoured by high temperature, low oxygen content of metal (*i.e.*, high carbon), low slag volume, and other items, such as slag basicity in the basic process.

Knowledge of melting reactions, says the writer, is equally applicable to the problem of making steels of low contents of alloying elements, such as nickel, copper, molybdenum, chromium, manganese, and phosphorus. Since the first three elements are not oxidisable in the sense of the behaviour of the last three, it follows that they can be controlled best by dilution. The oxidisable elements, however, can be minimised by inverting the steps mentioned for high recovery; thus elimination of chromium, manganese, and phosphorus is favoured by low temperature, high oxygen content of metal and high slag volume.

# JIG-SAW IN STEEL...

Here are just a few of the parts of a modern locomotive that are cut out of steel plate by the oxygen flame-cutter; cut to such fine limits, too, that in most cases no machining is necessary. Speeding things up in this way is only one example of the many activities of the compressed gas industry which is helping to make this country one of the principal workshops of the world.

Where cylinders are used please have your empties ready for collection when our lorries call.

THE BRITISH OXYGEN COMPANY LIMITED

LONDON & BOC BRANCHES

## COMPANY RESULTS

*(Figures for previous year in brackets.)*

**Hadfields**—Final dividend of 15%, making 22½% (same).

**Lightalloys**—Interim dividend of 7½d. per 5s. share (same).

**Staveley Coal & Iron**—Interim dividend of 2½%, tax free (same).

**British Aluminium**—Final dividend of 7% (same), making 10% (same).

**Beans Industries**—Final dividend of 27½% (same), making 37½% (same).

**Switchgear & Cowans**—Net profit for 1944, after taxation, £22,632 (£22,653); dividend of 20%, £24,000 (same); to general reserve, £2,324 (£9,000); forward, £20,392 (£12,084).

**British Thomson-Houston**—Net profit, after taxation, for 1944, £596,527 (£580,362); depreciation, £228,975 (£226,435); to general reserve, £150,000 (same); dividend of 7% (same); forward, £255,704 (£248,368).

**John C. Parkes & Sons**—Net profit for the year ended December 31, 1944, after providing for taxation, etc., £4,543; final dividend of 1s. per share, less tax, making 1s. 6d. per share, less tax; forward, £12,521 (£11,019).

**Humphreys**—Profit for the year to November 30, 1944, £41,486 (£58,169); tax provision, £23,100 (£28,750); to general reserve, £25,000 (£50,000); ordinary dividend of 10% (same); forward, £51,122 (£65,487).

**Webley & Scott**—Net profit for 1944, after tax, £24,778 (£25,814); dividend of 15% (same) and a bonus of 10% (same); to general reserve, £15,375 (£10,000 to war contingencies reserve); forward, £24,240 (£24,259).

**Heenan, Beddow & Sturmey**—Trading profit to November 30, 1944, after tax, £11,997 (£14,440); to directors' fees, £267 (£254); to depreciation, £2,749 (£4,393); dividend of 15%, less tax, £5,062 (same); forward, £21,959 (£18,040).

**James Booth & Company**—Net trading profit for 1944, £104,989 (£92,397); preference dividend, £5,600 (same); ordinary dividend of 15%, £56,250 (same); to reserve, £30,000 (same); to staff fund, £5,000 (same); forward, £117,291 (£98,956).

**Coltness Iron**—Net profit for 1944, £169,401 (£156,340); to redemption and depreciation account, £85,000 (same); to staff retiring allowances reserve, £5,000 (same); to ordinary reserve, £20,000 (£15,000); final dividend of 15% (13½%), making 20% (18½%); forward, £262,190 (£261,663).

**Bairds & Dalmellington**—Net profit for the year ended December 31, 1944, after provision for depreciation, taxation and contingencies, £248,467 (£230,791); to general reserve, £100,000 (same); final dividend of 12%, less tax (same), making 16%, less tax (same); forward, subject to directors' fees, £180,269 (£165,801).

**G. D. Peters**—Net trading profit for 1944, after depreciation and E.P.T., £49,753 (£63,686); directors' fees, £3,982 (£3,908); profit, £50,704 (£63,575); to income-tax provision, £27,000 (£35,000); to staff reserve, £5,000 (same); final dividend of 7½% and cash bonus of 2½%, making 7½%, £13,289 (same); forward, £38,434 (£33,019).

**Dorman, Long**—Profit for the year ended September 30, 1944, after taxation, debenture interest and sinking fund, £1,147,666 (£894,830); preferred ordinary dividend of 16% (same); ordinary dividend of 8% (same); to depreciation, £275,000 (same); to general reserve, £250,000 (£150,000); to pension fund, £15,000 (same); forward, £71,433 (£63,171).

**Hammond Lane Foundry**—Profit for the year ended December 31, 1944, after charging depreciation and making provision for taxation and contingencies, £13,618; dividend on the 6% cumulative preference shares, less tax, £2,250; ordinary dividend of 10%, less tax, £6,250; bonus of 2½% on the ordinary shares, less tax, £1,562; to general reserve, £4,000; forward, £3,571 (£4,015).

**Lancashire Steel Corporation**—Profit for the year ended October 31, 1944, after providing for taxation, £591,061 (£458,646 for 10 months); central reserve for depreciation, £200,000; reserve for deferred repairs and maintenance, £60,000; reserve for increased cost of plant and buildings, £50,000; provision for war damage premiums, £18,800; general reserve, £75,000; provision for staff superannuation, £5,606; dividend of 7% on the "A" and "B" ordinary stocks; forward, £88,047 (£85,727).

**Birmingham Small Arms**—Trading profit for the year to July 31, 1944, after provision for E.P.T. and N.D.C., £1,340,371 (£1,306,952); depreciation, £221,538 (£255,636); special depreciation, £200,000 (same); debenture interest (gross), £54,624 (£56,033); directors' fees, £9,802 (£13,020); premium on redemption of debentures, £943 (£896); income-tax, £500,000 (£400,000); war damage contribution, £65,746 (£95,000); balance of profits retained by subsidiary company, £53,025 (nil); deferred repairs and contingencies, £60,000 (£107,097); net profit, £209,221 (£179,270); to general reserve in respect of debenture stock redeemed, £36,322 (£34,960); written off investments in subsidiaries, £100,000 (nil); dividends paid during year, £7,798 (same); dividends paid after July 31, 1944, £113,367 (same); forward, £213,189 (£261,455).

## CONTRACT OPEN

*Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.*

**Willenhall,** March 26—Iron castings, etc., during the 12 months ending March 31, 1946, for the Urban District Council. Mr. N. D. Martin, Council Offices, Willenhall.

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MR. J. F. KAYSER, president of the London Branch of the Institute of British Foundrymen, who has recently returned home after a prolonged visit to the United States, advises British foundrymen to learn all they can about the lost-wax process, as from what he saw in America, he considers this activity to be outstanding amongst the wartime achievements of overseas foundry practice.

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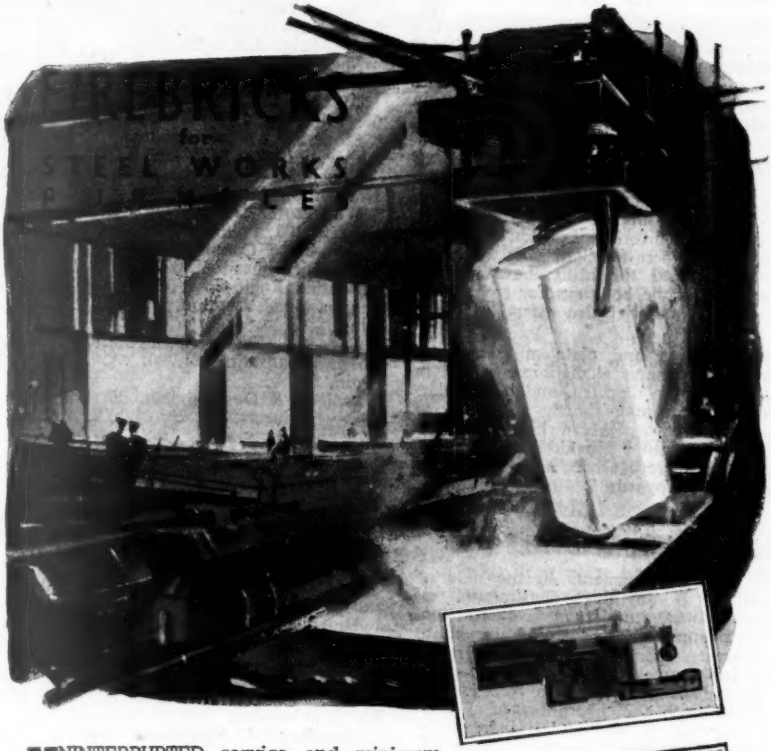




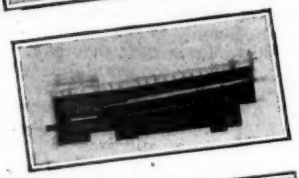

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# GLENBOIG

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# Raw Material Markets

## IRON AND STEEL

Demand is still sufficiently active to absorb the full output of pig-iron, the pressure for high-phosphorus grades having become particularly brisk since the revival of activity in the light-castings trade. There is, of course, considerable scope for further expansion at the foundries, but labour shortage is a limiting factor.

Steelmakers are placing substantial tonnages of billets, blooms and sheet bars at the disposal of the re-rolling plants, but many of these establishments are operating with very limited supplies of material in hand, and pressure for further deliveries of defectives as well as primes is unabated. Orders for light steel sheets are particularly extensive, and the mills have several months' work in hand, while bookings for small bars, strip and light sectional material also extend well into Period II.

While the heavy section and plate mills are still operating below capacity, some slight improvement in the flow of orders has been reported, and it is understood that export licences may shortly be issued to absorb any surplus outputs. Meanwhile, the locomotive, wagon and boiler shops provide steady support for the plate mills, and there has been a better flow of specifications from the shipyards.

## NON-FERROUS METALS

There are no fresh developments in the field of non-ferrous metals. If anything, consumption of copper would appear to have undergone a contraction, and there are ample supplies of lead and zinc about to feed the war factories. Tin supplies have undergone no increase, and can scarcely do so while the Far Eastern mines remain in the control of the enemy. On the other hand, with the liberation of France and Belgium, a potential, if not actual, increase in the number of users of the metal has taken place. It seems inevitable that economy in the use of the metal will have to be practised for a long time yet. Lead and zinc are being used in moderate quantities in connection with house repairs and in a few other directions outside the manufacture of arms and munitions, but the total quantity going into the manufacture of civilian goods is still relatively small. Aluminium is more freely available, and its use will be stimulated by the recent reduction in price and the removal of some of the restrictions on distribution of the metal.

THE IMPORTANCE of the Pacific Coast of the United States as a metallurgical area is stressed by the fact that at the Kaiser Company's Fontana Works six 185-ton tilting open-hearth furnaces have been installed. It is already famous as an aircraft-building centre.

## NEW COMPANIES

(*"Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.*)

**Bescot Steels,** Brockhurst Crescent, Walsall—£1,000.

**Fireclays (Elland)**—£2,000. C. Jowett, 9, Daisy Road, Brighouse (subscriber).

**Sheet Alloy Pressings,** 7, Whitcher Gate, Camden Town, London, N.W.1—£10,000.

**Metallic Bronzing**—£100. J. F. C. and C. M. Bull, 66, Lillie Road, London, S.W.6.

**Stone-Fry Magnesium,** Prince Georges Road, Merton Abbey, London, S.W.19—£10,000.

**Coochdale Engineering Services,** 2a, Avenue Road, New Bilton, Rugby—£1,000. C. and J. V. Cooper.

**Whitecroft Engineering Company**—£10,000. G. Conrad, 103, Phyllis Avenue, New Malden, subscriber.

**Wharton & Company (Pattern Makers),** 32a, Camden Street, Birkenhead—£300. E., J. R. and M. A. Turner.

**Fonthill Engineering Company,** 6-7, Fonthill Mews, Lennox Road, London, N.4—£700. A. W. and W. C. King.

**Garnett (Engineering),** Station Gates, 1, Lloyds Road, Broadstairs—£1,000. A. J. Garnett and A. J. Pepin.

**Projects & Development,** 26, Tontine Street, Blackburn—Engineers, etc. £1,000. R. D. and J. O. Millar.

**Linton Bros. (Newport),** Goodrich Engineering Works, Malpas Road, Newport, Mon—£5,000. W. Linton.

**Commercial Welding Company,** Collingdon Road, Cardiff—£3,000. H. D. Evans, R. J. Frisk, and J. J. Jenkins.

**Richhall Engineering & Contracting Company,** 6-7, Queen Street, London, E.C.4—£1,000. T. Corrigan and H. E. Filby.

**Anderson, Rigden & Perkins,** The Shipyard, Island Wall, Whitstable—Shipbuilders, etc. £15,000. S. and R. K. Anderson.

**Vericast**—Manufacturers of metal dies and moulds. £10,000. V. M. Ormerod, 55, Pall Mall, London, S.W.1, subscriber.

**Metallurgical Equipment Export Company,** 17, Victoria Street, London, S.W.—Engineers, research workers, etc.—£100.

**H. H. White & Company (Wembley),** 208, Bridgewater Road, Wembley—Engineers, etc. £2,000. H. H. and A. White.

INDUSTRIAL DEVELOPMENT in Manchester was discussed at a meeting of Manchester City Council recently, when fears of the possible restriction of developments by the Government under its Distribution of Industry Act were expressed. The discussion was prompted by the course of negotiations regarding the conversion of the Vickers-Armstrong factory, Openshaw, into storage accommodation. It was reported that there had been a meeting with the Members of Parliament for the city, who had been asked to use their influence with the Board of Trade to retain the factory in active working.